Charcoal cost development in Zambia

Anders Ellegård

Initially, one of the major reasons to intervene in the charcoal system was for purely social reasons. With the knowledge of increasing oil prices in the western world during the seventies, the "energy crisis of the third world" was discovered. This was based, among other things, on the very high price increases. In the table below, charcoal price increased by 80% in the five years between 1978 and 1983. In the next five years it increased seven-fold and between 1988 and 1989 there was a three-fold increase in only one year!

Year	Charcoal cost *Kwacha/bag*
1978	3
1983	5
1988	30
1989	100
1992	350
1993	1300
1994	2150
1995	2650

Table 1: Charcoal prices in Kwacha, 1978-1995

This was a view of the reality that compelled scientists and officials to attempt to figure out measures to reduce dependence on charcoal in the first place. But viewed in another perspective, and taking account of the inflation and depreciation of purchasing power of the Kwacha, the situation is different. In this perspective, the charcoal price had been surprisingly stable over the years, at an equivalent of around 3.80 USD per bag.

Year	Charcoal cost *Kwacha/bag (1995)*	Charcoal cost *USD/bag*
1978	3362	3,87
1983	3155	3,64
1988	4026	4,64
1989	5872	6,77
1992	967	1,11
1993	3301	3,80
1994	3085	3,56
1995	2650	3,05

Table 2: Charcoal cost in fixed prices

An exceptional increase was found in 1988/89, when the price increase was around 100% in real terms. In 1992, there was an equally exceptional situation, but then the price was reduced to only a third of the common price. In both cases, the charcoal price was back to normal within a year.

Prices in running costs gave no clue to these changes. In both cases, the dramatic change in charcoal price in the short term was affected by the weather. In 1989/89 there was an exceptionally heavy rain period, and in 1992 there was a draught.

The rain period affects the charcoal prices in two ways. Transportation of charcoal in the bush becomes extremely difficult, if not entirely impossible. In addition, the rains make agricultural production more viable, and many persons, who would otherwise have made some charcoal, instead settle for crops.

A draught period is the opposite. In such a situation the access to production areas is uninterrupted all year round. In addition, the crops fail and the rural farmer has little option but to burn charcoal in order to generate at least some income for the family. The result is increased supply of charcoal on the urban markets, and reduced prices.

This observation is not to imply that a short-term price increase does not burden low-income households, but rather to show that rather than an exceptional price increase (over 100-fold in current terms), the charcoal price has been surprisingly stable over the years. This suggests that the supply of charcoal has not been in jeopardy, during this whole period, in spite of dramatic increases in consumption of charcoal.

Main source:

Kalumiana, O.S., Hibajene, S.H. and Ellegård, A. 1998: *The charcoal storage disaster. The Lusaka charcoal supply stabilization project*. Stockholm Environment Institute: Energy, Environment and Development Series No 45 (32 pp.)

SEI STOCKHOLM ENVIRONMENT INSTITUTE

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To Table of Contents of this issue

Charcoal Utilisation in Zambia

by Anders Ellegård, SEI

The Stockholm Environment Institute is cooperating with the Department of Energy of the Ministry of Energy and Water Development in Zambia in order to determine the long-term viability of the charcoal utilisation system in Zambia. Several areas have been studied, from the natural production of forest biomass through charcoal conversion and transportation to different aspects of end-use of charcoal. Further, some of the alternatives to charcoal use for low income households have been studied. Some of the studies have been completed and others are in progress.

Emmanuel Chidumayo of the University of Zambia headed a project where it was found that deforestation due to woodfuel production from miombo woodlands is a temporary problem. If large-scale utilisation of forest biomass for fuel production is foreseen, it will, however, become necessary to introduce sound management practices to ensure long-term productivity in sensitive areas.

Environmental impacts of the charcoal production and utilisation system were studied by a group headed by W. Seren of the Department of Energy, and including E. Chidumayo, J. H. Chipuwa, Dr. Hans Egn, SEI and Anders Ellegård, SEI. It was found that the environmental impacts are limited, both in time, area and quantity. Soil nutrient and water status are only temporarily affected, and in comparatively small areas.

Conversion of wood biomass into charcoal was studied by S. H. Hibajene and O. S. Kalumiana at the Energy Department. It was found that the traditional method of charcoal production is less wasteful than previously assumed.

Transportation and distribution of charcoal is generally effective, given the resources allocated to this sector. A compilation of current information in the field was performed by Hibajene and Ellegård. There are wide seasonal variations in charcoal supply (and hence price) to the urban areas.

Price mechanisms for both charcoal and its transportation are still poorly understood. A project to investigate the possibilities for charcoal storage is planned for 1994-95, headed by P. Chishimba of the Ministry of Energy.

The living conditions of charcoal producers are severely substandard compared to similar groups in urban areas, or even other rural communities. However, health effects directly related to charcoal production as opposed to other for work could not be substantiated.

A study on the expenditure on charcoal in urban households was performed by P. Chiwele, Energy Department, R. Siamwiza, UNZA, J. B. Muchelemba, UNDP and A. Ellegård. It was found that the expenditure on charcoal only represents a small fraction of that spent on foodstuffs, indicating that no shortage of charcoal is perceived at present, least during the dry season. However, urban households appear to be ready to adopt energy saving measures, should need arise.

A relatively large number of housewives are exposed to levels of carbon monoxide in excess of internationally recommended levels. High levels of carbon monoxide emissions were found from charcoal using the traditional mbau

(stove). This warrants efforts to design stoves and kitchens in order to reduce exposure to pollution from charcoal.

Electricity as an alternative to charcoal was found to be expensive in a study carried out by Hibajene and Kaweme of the Zambia Electricity Supply Company (ZESCO). With current practices it is not a viable alternative for lowincome groups. Two SEI reports from this project are available.

A pilot project is proposed to test a lowcost approach to electrification and determine whether this could assist in making electricity more affordable for lowincome urban households. This project would start later in 1994, pending confirmation of funding.

These projects formed most of the background material for a workshop held inSiavonga, Zambia, May 10-14, 1993, with the purpose of advising the Zambian government on charcoal utilisation policy. A summary of the reports presented is available from SEI or the Department of Energy.

A general conclusion is that the charcoal utilisation system appears viable, functional and economic from most points of view. The challenge is how to manage and improve the system, rather than to substitute it for another at the presen time.

To Table of Contents of this issue

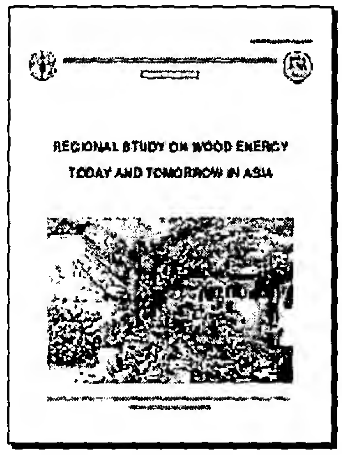
To *Renewable Energy for Development* index

Regional Study on Wood Energy Today and Tomorrow

RWEDP Home
Publications
Newsletter
Wood Energy Issues
Member Countries
Database
Links
About RWEDP
Contact RWEDP
Search

Field Document No.50, October 1997

Table of Contents


REGIONAL STUDY ON WOOD ENERGY TODAY AND TOMORROW IN ASIA

This field document is an outlook on wood energy in Asia up to the year 2010. The study has been prepared by RWEDP staff at the request of the Asia-Pacific Forestry Commission, as a contribution to the upcoming Forestry Sector Outlook Study for the Region.

The document summarises characteristics of wood energy supply and use, and provides an outlook on wood energy to the year 2010. The document presents a critical review of available wood energy data, leading to best estimates of future consumption. It also tries to estimate the present and future potential supplies of fuels from wood and crop residues. The study shows that in most countries, the actual availability of woodfuels is not the major concern; rather it is their distribution to people in need.

This point leads to recommendations to policy makers on how best to integrate woodfuel supply with other objectives, particularly in the forestry sector. The integration of woodfuel development in other relevant sectors like agriculture and energy is also strongly recommended. The document further calls for efforts to upgrade fuels from crop residues by using cost-effective technologies.

Greenhouse gas implications of wood energy use in RWEDP member countries are discussed. It is estimated that in 1994 emission of some 560,000 kton of CO_2 was avoided by the use of woodfuels as compared to coal as a (hypothetical) alternative. This figure will increase to about 700,000 kton by the year 2010. When capitalised in terms of avoided costs for CO_2 abatement, this leads to an indicative figure of 28 billion US$ annually (respectively 35 billion US$).

The study reveals the weaknesses of available data and cautions about scenario development which lacks substantial basis. One of the striking messages is that the future of Asia's tropical forests and the problems of woodfuel users are not as closely linked as is often assumed.

Table of Contents

Appendices

Boxes

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Back to the top

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Implications of Woodfuel Use for Greenhouse Gas Emissions

Regional Study on Wood Energy Today and Tomorrow

RWEDP Home
Publications
Newsletter
Wood Energy Issues
Member Countries
Database
Links
About RWEDP
Contact RWEDP
Search

Field Document 50, chapter 9 Table of Contents

CO2 Emissions - Example: Benefits of Wood Energy Development - Global Environment Policy - Summary for 16 RWEDP Countries

9.1 CO2 Emissions

The implications of woodfuel use for the global environment can be evaluated by estimating the associated greenhouse gas emissions. As CO2 is the main greenhouse gas, it only (carbondioxide) will be considered here, leaving aside gases like methane and other carbon-hydrogens. Any emissions caused by woodfuels can be compared with emissions from alternative fuels.

Though combusting wood emits CO2 into the atmosphere, regrowth of wood captures CO2 from the atmosphere. As a first approximation it can be stated that woodfuel use is carbon neutral, i.e. there is no net emission of carbon into the environment. The approximation is supported by the evidence of two dominant mechanisms. First, most woodfuel use takes place on a sustainable basis. This applies to the use of virtually all woodfuels originating from non-forest land (e.g. agriculture land, plantations and homegardens), and to the use of most of the woodfuels from forest land. Sustainability implies carbon neutrality, because the same amount of CO2 emitted by wood combustion, is recaptured from the atmosphere by regrowth of wood. Second, leftovers from non-sustainable logging and land conversion, if not used as fuel (or for other purposes) would simply decompose by natural processes, and lead to the same amount of carbon emitted in the atmosphere if the woody material were to be combusted (though not necessarily distributed amongst CO2, methane and other greenhouse gases in the same way).

Obviously, if woodfuels were not utilised, some alternative energy source would be required and used. For most applications and in most countries, the hypothetical alternative would be a fossil fuel, i.e. coal, gas, or oil products. For few applications and in few countries, hydro and wind power could be the hypothetical alternative, whereas within the next 15 years or so the option of other renewables like solar photo-voltaics is likely to be negligible in terms of energy quantity. The effects of fossil fuel use on the global atmosphere have been well documented. Typical data for the emission of CO2 per fuel and per unit of energy are available from the LEAP Environmental Database (SEI, 1995). Furthermore, the other renewable energy sources are considered to be carbon neutral, like wood.

The implications of woodfuel use in Asia for the global environment can then be evaluated by estimating how much CO2 emission from hypothetical alternatives is avoided by woodfuel use. The most likely (or least unlikely) mix of alternative energy sources varies per country. For the purpose of the present study, LPG can be considered the alternative. This leads to a simplistic though conservative estimate, because per unit of energy coal emits about 33% more and kerosene 7% more CO2 than LPG1. The results are summarised in Table 9.1 and presented fully in Table 9.2. Switching between wood and other biomass fuels like agroresidues is ignored, because carbon neutrality applies to the other biomass fuels for the same reasons as for wood.

From Table 9.2 it is seen that in 1994 woodfuel use aggregated for the RWEDP member-countries results in avoided emission of about 277,683 kton CO2 per annum as compared to hypothetical LPG use. This equals an average of 6 percent of the current CO2 emission due to total fuel use in the same countries. By the year 2010 the figures would be 349,615 kton and 3% on average, respectively.

The economic benefit of current woodfuel use in Asia for the global environment can be appreciated by estimating the cost which would otherwise be required for avoiding or recapturing the emitted CO2 from the atmosphere. Cost estimates for the latter vary a lot, depending on conditions and technological options (like removal, storage, recapturing, avoiding, etc., of the CO2). Based on IPCC estimates (IPCC, 1997) 50 US$ per ton avoided/recaptured CO2 is a typical figure within the present range of options. Hence, it can be estimated that in 1994 about 14 billion US$ and in 2010 about 17 billion US$, for CO2-related costs are avoided by woodfuel use in RWEDP membercountries.

9.2 Example: Benefits of Wood Energy Development

The above estimates allow us to evaluate the benefits of a wood energy development programme like RWEDP for the global environment. RWEDP incorporates, amongst others, various activities in wood energy conservation, e.g. the promotion of improved stoves. This is being achieved in co-operation with government institutions, NGO's and donor agencies. When conservation is achieved, the ever increasing energy demand in the region can partly be met by available woodfuels, rather than fully resorting to additional fossil fuel with their associated CO2 emissions. However, as firm data on achievements in wood energy conservation are not (yet) available, some assumptions have to be made2.

The break-even point of a programme like RWEDP in terms of costs versus benefits for the global environment can be estimated as follows. On the cost side, the Dutch Government through FAO has allocated to RWEDP a total of 15.2 million US$ over the period 1984-1999. On the benefit side, the same figure as above (50 US$/ton) for recapturing/avoiding CO2 from the atmosphere can be applied. 'Environmental break-even' can thus be calculated for RWEDP in terms of avoided CO2. This leads to the following results:

- If break-even is to be reached within, say, 10 years, a modest annual

contribution from RWEDP of only 0.01% to wood energy conservation in the region would suffice. In fact, claiming such a limited impact seems to be very modest, perhaps even unrealistically small.

- If alternatively, the contribution of RWEDP to wood energy conservation in the region is assumed to be, say, 0.1% (which still seems to be modest3), the pay-back period of RWEDP would be only 11 months.

It should be noted that RWEDP has several objectives other than contributing to reducing greenhouse gas emissions. In fact, RWEDP's activities aim to support 6 sectoral priorities, of which only one is the environment, both locally and globally.

For comparison it is noted that the Government of The Netherlands has allocated the equivalent of 375 million US$ in its national budget for 1997 in order to achieve reduction of 15,290 kton CO_2 emissions into the global atmosphere in 5 years time, i.e. 3,058 kton per annum (Ministry of Agriculture, Nature Protection and Fisheries, 1997). This implies that the budget allows for a cost of 123 US$/ton CO_2. The programme will be implemented jointly by three Ministries (Economic Affairs, Environment, and Agriculture). It is quite likely that the same effect in terms of avoiding global CO_2 emission can be achieved by the Ministry for Development Cooperation and FAO via a dedicated wood energy conservation programme in Asia with a limited budget.

9.3 Global Environmental Policy

Many general policies regarding wood energy and environment are still based on the exceptional cases, i.e. the relatively few areas where woodfuel use is not sustainable. This even leads to donor policies for promotion of fuel transition, i.e. away from woodfuel towards fossil fuels or towards expensive forms of renewable energy. However, from available evidence it must be concluded that most woodfuel use takes place on a sustainable basis. Therefore it is more beneficial if people stick to the practice of woodfuel use for their daily needs. In terms of quantity of avoided CO_2 emission, the very fact of using wood energy by the majority of people is even more important than adoption of efficient wood stoves by a limited number of users. This observation may redirect priorities within wood energy conservation programmes. Rather than targeting at maximum efficiency of stoves with associated price increase of appliances, priorities should be for convenience, health and overall attractivity at affordable prices, so as to reach the maximum number of wood energy users. For areas where, indeed, woodfuel practices are not sustainable, tailor-made programmes should be designed.

As far as carbon sequestration through reforestation, afforestation and/or forest rehabilitation is an objective of present global environmental policies, it is obvious that such forest-related activities will be economically more feasible when the new or upgraded forest resource base will be available for sustainable use of wood and non-wood products. Sustainable woodfuel use qualifies as one of the prime applications in this context.

The above policy considerations are not only relevant for international agencies, but also for forest policy makers in Asia and the Pacific for an outlook to the year 2010. Further programmes and projects targeting wood energy development could be prepared and justified with a view to substantial global environmental benefits, not only for present RWEDP member-countries, but also for other countries in the AsiaPacific region.

Table 9.1: Summary for 16 RWEDP countries

Environmental effects (kton)	**1994**	**2010**
CO_2 emission from fossil fuels*	4,317,000	10,602,000
avoided CO_2 emission by woodfuel use:		
- as compared to LPG	278,000	349,000
- as compared to kerosene	334,000	420,000
- as compared to coal	560,000	703,000
avoided CO_2 costs, as compared to LPG (million US$)	14,000	17,500
Environmental break-even of woodfuels as compared to LPG		
If in 10 years, RWEDP should result in: 0.01% per annum w.e. conservation		
or if 0.1% p.a. wood energy is conserved via RWEDP: pay-back in 11 months		

**1994 data from ORNL, 1997. 2010 projections made using projected growth rates from ESCAP 1997b.*

Back to the top

Table of Contents

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EE&D Project

Charcoal supply stabilisation

It had been noted that urban charcoal prices increase substantially during years with good rain. This is attributed to the difficulties in transporting charcoal from rural production sites, but also due to difficulties of producing charcoal during the rainy season. In order to reduce the hardships of the poor urban households it was proposed that charcoal should be bought during the dry season and stored in large quantities near urban centres. Charcoal would then be sold during the rainy season at a reasonable price. In order to test this idea, an experiment was carried out with storage of almost 10,000 bags of charcoal in the dry season of 1994. The result was disastrous from the economic point of view but yielded interesting information on the realities of the charcoal trade.